REMARKS

By this amendment, claims 2, 5, 7-9 and 12-13 have been cancelled, claims 1, 3, 4, 6, 10 have been amended in the application and new claims 14-15 have been added in the application. Currently claims 1, 3-4, 6, 10-11 and 14-15 are pending in the application.

Claims 1-13 were rejected under 35 U.S.C. 102(e) as being anticipated by Tadauchi et al. (U.S. Patent No. 6,673,310).

Claims 1-6, 8, 10 and 12 were also rejected under 35 U.S.C. 102(e) as being anticipated by Japanese Patent Application Publication No. 56-069341 (JP '341).

Claims 7, 9, 11 and 13 were rejected under 35 U.S.C. 103(a) as being obvious over Japanese Patent Application Publication No. 56-069341.

These rejections are respectfully traversed in view of the amendments to the claims and the following remarks.

By this amendment, claim 2 has been cancelled and its subject matter has been substantially incorporated into claim 1 so as to clarify the present invention.

The present invention according to amended claim 1 is therefore related to "a lead-free solder, which contains 30 to 70

weight percent zinc, greater than 0 to 5 weight percent nickel, and the remaining weight percent tin with a liquid phase temperature of 260°C or greater". By this amendment, 0 weight percent nickel is excluded thereby clarifying the lower limit of the nickel amount in the lead-free solder.

Claim 3 has been amended so that the amount of aluminum contained in the lead-free solder excludes 0 weight percent.

Claim 4 has been amended to clearly define the function of copper in the lead-free solder.

The Examiner stated that Tadauchi et al. teach a lead-free solder comprising zinc (30 to 95 wt%) and tin (70 to 5 wt%) (col. 4, lines 49 to 52). However, Tadauchi et al. simply disclose a "Sn/Zn/Ag Solder Material" for implementing a high-temperature solder. The "second type" of silver incorporated tin/zinc compositions is described as "the silver/zinc compound" and is produced by incorporation of silver, which concentrates the metallographic structure to increase the mechanical strength" (col. 3, line 65 to col. 5, line 1). In Tadauchi et al., advantages or effects of a solder in which silver is incorporated are described, but Tadauchi et al. fail to disclose a solder without silver. "The second type" is consistently described as a tin/zinc/silver solder.

Accordingly it can be perceived that silver is an indispensable component in the solder of in Tadauchi et al. Therefore, incorporation of silver into a tin/zinc (Sn/Zn) solder is an essential part of the invention described in Tadauchi et at.

The lead-free solder according to the present invention does not contain silver as a solder component. The reasons for avoiding silver are: (i) silver is expensive and it raises the price of the solder, and (ii) silver combines with tin which is one of the solder components, to generate an intermetallic compound (Ag_3Sn), thus aggravating adhesiveness of the solder on the joint interface. Such an adverse effect is not directly disclosed in the specification, however it is well known in the art.

As described above, a lead-free solder of the present invention which needs no silver is completely different in solder components from Tadauchi et al. in which silver is absolutely necessary. It is therefore apparent that Tadauchi et al. do not teach or suggest the present invention.

The Examiner pointed out that Tadauchi et al. teach a solder containing component such as nickel, aluminum and copper at an amount not higher than 0.5 wt% (col. 6, lines 3 to 18). In

Tadauchi et al., such components are added in order to protect a tin/zinc/silver solder from deterioration with time. There is no clear explanation about "deterioration with time" in Tadauchi et al. Judging from disclosure of "a thermal cycle test (TCT)", that deterioration indicates a mechanical fault resulting from thermal fatigue (col. 10, lines 45 to 62). Therefore, this point also makes Tadauchi different from the present invention.

More specifically, in the present invention, nickel or copper is added for the purpose of controlling intermetallic compound growth. It is also disclosed that increasing the nickel content amount proportional to the content amount of zinc is effective to control intermetallic compound growth. This feature is not suggested by Tadauchi et al.

In addition, Tadauchi et al. disclose nickel, copper and aluminum, simply by way of example, which are included in many other components such as scandium, yttrium and the like. Tadauchi et al. provide no specific advantage of adding such components. It is not clear that the same effect on the solder can be obtained for all of these components. Furthermore it is apparent that Tadauchi et al. is different from the present invention in that silver is included as a component in Tadauchi et al. as described above. Accordingly Tadauchi et al. do not

suggest a lead-free solder containing components such as nickel, aluminum and copper as disclosed in the present invention.

The Examiner also stated that Tadauchi et al. teach the members joined with the solder include copper (col. 5, lines 51 to 58). However, Tadauchi et al. only refer to the generally-known fact that it is desirable that prior to soldering, the oxygen content on the surface of the copper to be soldered may be reduced.

On the other hand, a lead-free solder according to the present invention is different from the solder of Tadauchi et al. in that the nickel-added or copper-added lead-free solder is well suited to soldering copper material. Moreover, the specification shows that the solder of the present invention requires no surface treating such as undercoating the copper material with nickel prior to soldering. This is not taught by Tadauchi et al.

Regarding JP '341 (Japanese Patent Application Publication No. 56-069341), the Examiner stated that JP '341 teaches a solder comprising zinc, silver and/or copper and the balance tin. JP'341 however fails to disclose a solder containing zinc, tin and nickel as recited in amended claim 1, and a solder further containing aluminum as recited in amended claim 3.

JP '341 is totally different from the present invention as far as its application or usage is concerned. That is, in JP '341, the solder has been made for joining the inner wire of a control cable to connector terminal metal fittings and for improving its bonding strength. Unlike a lead-free solder according to the present invention, the JP '341 solder is not intended to have stable electrical characteristics at the soldered joints.

Consequently, for at least these reasons mentioned above, it is apparent that a lead-free solder and a lead—free joint set forth in independent claims 1, 4 and 6 are different in their components, properties, usages or the like from a solder and solder material disclosed in Tadauchi et al. and JP'341.

Applicants also respectfully submit that the present invention is not taught or suggested by anything found or pointed out in these references and the features of the amended claims are not rendered obvious by the cited prior art references.

In view of foregoing claim amendments and remarks, it is respectfully submitted that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding this amendment or the remarks, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,

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